DEVELOPMENT OF LONG-TERM SUSTAINABLE WATER SUPPLIES FROM THE MIOCENE UPPER AND LOWER BRUNSWICK AQUIFERS, GLYNN AND BRYAN COUNTIES, GEORGIA

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Abstract. Three potential aquifers in Miocene and younger sediments have been recognized in the 24-county coastal area of Georgia. The three aquifers, in descending order, are the surficial aquifer (in late Miocene to recent age sediments), and the upper and lower Brunswick aquifers (in early Miocene age sediments). Until 1997, the Miocene aquifers of coastal Georgia had received little attention as an alternative groundwater source. At this time, the Georgia Environmental Protection Division (EPD) placed restrictions on the future development of the upper Floridan aquifer system in coastal Georgia because of the threat of saltwater contamination in Savannah and Brunswick.

The upper and lower Brunswick aquifers have been tested in Glynn and Bryan Counties, Georgia. A 1-million gallons per day (MGD) production well at the Golden Isles Gateway Tract near the Glynn County Airport has been in operation for over 1 year as part of the Glynn County Water Supply System. No adverse impacts to long-term water supply have been observed. Additional testing in Bryan County also produced favorable prospects for the lower Brunswick aquifer as a potential alternative water supply.

Hydrostratigraphic and hydrogeologic studies currently are underway to further define the thickness, aerial extent, and hydrologic properties of the surficial, and upper and lower Brunswick aquifers in Georgia's 24-county coastal area.

INTRODUCTION

In 1997, the Georgia EPD placed restrictions on the future development of the Upper Floridan aquifer in coastal Georgia because of the threat of saltwater contamination at Savannah and Brunswick (Figure 1). In October 1998, Glynn County submitted the final draft of its long-term Water Resources Management Plan, as required by the Georgia EPD. Prepared by Jordan, Jones & Goulding, Inc. (JJ&G), this study recommended continued development of the Miocene aquifers for short-term needs through the year 2004, and completion of studies of Miocene aquifer potential in Glynn County.

A test well was drilled to evaluate the hydrologic conditions at the Golden Isles Gateway Tract in the north mainland area of Glynn County to determine the potential for development of the Miocene aquifers for a sustainable public water supply. The drilling and testing of production well No. 1 resulted from the favorable results developed from the preliminary evaluation of the Miocene aquifers at the Golden Isles Gateway Tract.

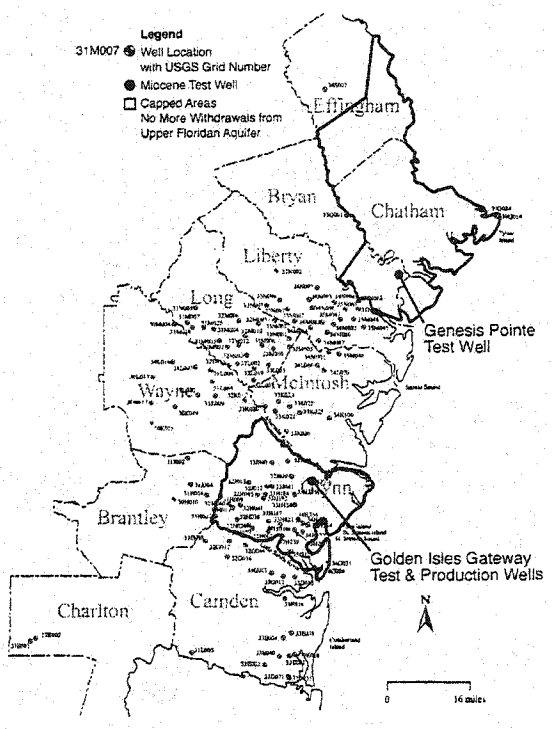

Figure 1. Location of Miocene test wells in coastal Georgia.

HYDROGEOLOGIC CHARACTERISTICS OF THE GOLDEN ISLES GATEWAY TRACT

The site geologic units, as defined by P.F. Huddleston (1988) and L.E. Edwards and R.E. Weems (2000); and the aquifer and confining units, as defined by Clarke (1990); are shown on Figure 2. This information is correlated on the borehole geophysical logs from the original test well and the production well, which are separated by a distance of 3,000 feet. The aquifer and confining units at the Golden Isles Gateway Tract, in descending order from the ground surface, are shown in Table 1 below.

The production well was fully screened in both the upper and lower Brunswick aquifers. A 25-hour aquifer test was conducted between August 18 and 20, 1998, at a pumping rate of 1,500 gallons per minute (gpm). Water level recorders were installed in 2 observation wells located 3,000 feet north of the pumping well, one tapping the upper Brunswick aquifer and the other the Lower Brunswick aquifer. The U.S. Geological Survey (USGS) conducted a second 5-hour flow meter test in the production well on August 27, 1998, to determine the relative percentage of yield from the upper and lower Brunswick aquifers. The flow was about equally divided from each aquifer (L.E. Jones, 1998).

Aquifer test data were matched to type curves using the Theis (1935) and Walton (1962) methods for confined aquifers utilizing the data analysis program, Infinite Extent version 4.0 by Starpoint Software. The transmissivity determined for the upper Brunswick aquifer from the two methods for the draw down data ranged from 3,215 to 3,355 square feet per day (ft^2/day). The storativity ranged from 3.6×10^{-5}, to 3.3×10^{-5}, and the hydraulic conductivity ranged from 37 to 35 ft/day. The recovery data for the upper

Table 1. Aquifer and Confining Units At The Golden Isles Gateway Tract

Aquifer\Confining Unit	Formation	Age
Water Table Aquifer	Satilla Formation	Pleistocene
Upper Confining Unit	Ebenezer Formation	Late Miocene
Surficial Aquifer	Ebenezer Formation	Late Miocene
Berryville Confining Unit	Coosawhatchie Formation	Middle Miocene
Upper Brunswick Aquifer	Marks Head Formation	Early Miocene
Middle Confining Unit	Parachucla Formation	Early Miocene
Lower Brunswick Aquifer	Tiger Leap Formation	Early Miocene
Lower Confining Unit	Tiger Leap Formation	Early Miocene
Upper Floridan Aquifer	Suwanee\Ocala Limestone	Oligocene\Eocene

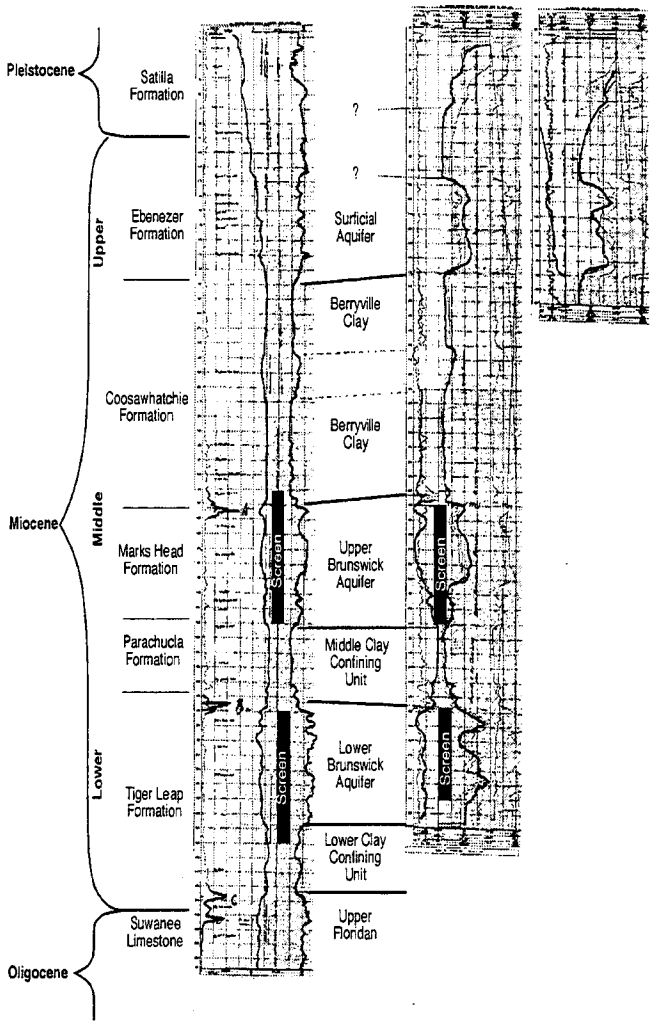

Figure 2. Borehole geophysical logs of the Golden Isles Gateway Tract Wells.

Brunswick aquifer using the Walton and Hantush (1956) methods indicated a transmissivity of 3,502 ft^2/day, a hydraulic conductivity of 35 ft/day, and a storavity of 3.3×10^{-5}.

Hydraulic properties for the lower Brunswick aquifer were determined by the Theis curve matching method. The transmissivity for the lower Brunswick aquifer was 2,828 ft^2/day, the hydraulic conductivity was 35 ft/day, and the storavity was 1.4×10^{-4}.

Test results indicated that it was feasible to design a single multi-aquifer well capable of supplying 1 MGD. The well would tap both the upper and lower Brunswick aquifers and obtain half of its total yield of 700 gpm from each aquifer (350 gpm from both the upper and lower Brunswick aquifers). The well has been in operation since May 1999 and meets the needs of the Glynn County Water System in the North Mainland area. Groundwater levels at the Golden Isles Gateway Tract have been continuously monitored by

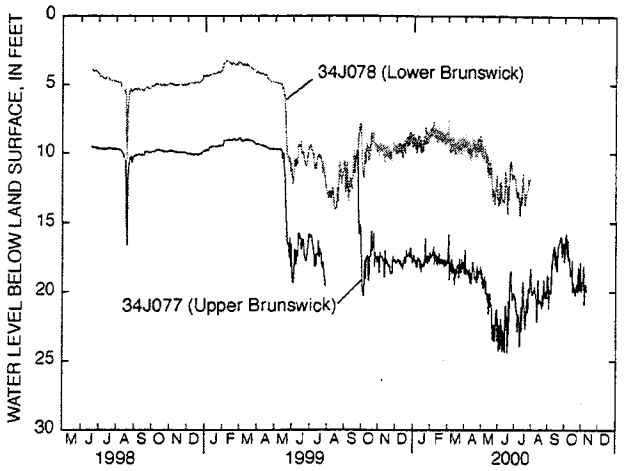

Figure 3. Water levels in the upper and lower Brunswick aquifers at the Golden Isles Gateway Tract, Glynn County, Georgia, 1998-2000.

the USGS since June 1998 (Figure 3). When pumping at the site was initiated on May 19, 1999, water levels declined about 8 feet in the upper Brunswick aquifer and about 5 feet in the lower Brunswick aquifer. Since this initial decline, water levels have shown increased fluctuations due to pumping, but little downward trend.

HYDROGEOLOGIC CHARACTERISTICS OF THE GENESIS POINTE TRACT

The hydrogeologic conditions at the Genesis Pointe Tract in Bryan County, Georgia, were evaluated to determine the potential for development of the upper and lower Brunswick aquifers for a sustainable public water supply. Drilling operations began at the Genesis Pointe Tract on June 1, 1999. The 6-inch diameter mud rotary test hole was drilled to a depth of 340 feet. Samples were collected every 10 feet, and bagged and labeled by the driller and site geologist. A geologic log of the formations penetrated was prepared.

The borehole geophysical logs for Test Well No. 1 (Figure 4) were used to assist in the definition of the lithologic units penetrated in the test boring. The natural gamma ray log is displayed on the left. The Miocene marker beds A, B, and C are marked by prominent increases in natural radiation. The Self-Potential and Resistivity log are displayed to the right. This log response, along with the mud rotary samples and geologic log, was used to define the hydrogeologic framework.

The site geologic units and the aquifer units are shown on Figure 4. The water-bearing units at the Genesis Pointe Tract, in descending order from the ground surface, follow in Table 2. The lower Brunswick aquifer is the only lower Miocene aquifer present at the Genesis Pointe Tract. The lower Brunswick aquifer occurs between 273 and 300 feet. The confining layer between 300 and 325 feet separates the lower Brunswick aquifer from the underlying upper Floridan aquifer.

A 48-hour aquifer test was conducted between June 15 and 18, 1999, on Test Well No. 1. Observation Well No. 2, located 275 feet from the pumping well, was used as an observation well. The pumping well was equipped with a 90 gpm submersible pump powered by a diesel generator. Water level measurements were recorded manually with an

Table 2. Waterbearing Units At The Genesis Pointe Tract

Aquifer\Confining Unit	Formation	Age
Water Table Aquifer	Satilla Formation	Pleistocene
Lower Brunswick Aquifer	Tiger Leap Formation	Early Miocene
Upper Floridan Aquifer	Suwanee/Ocala Limestone	Oligocene/Eocene

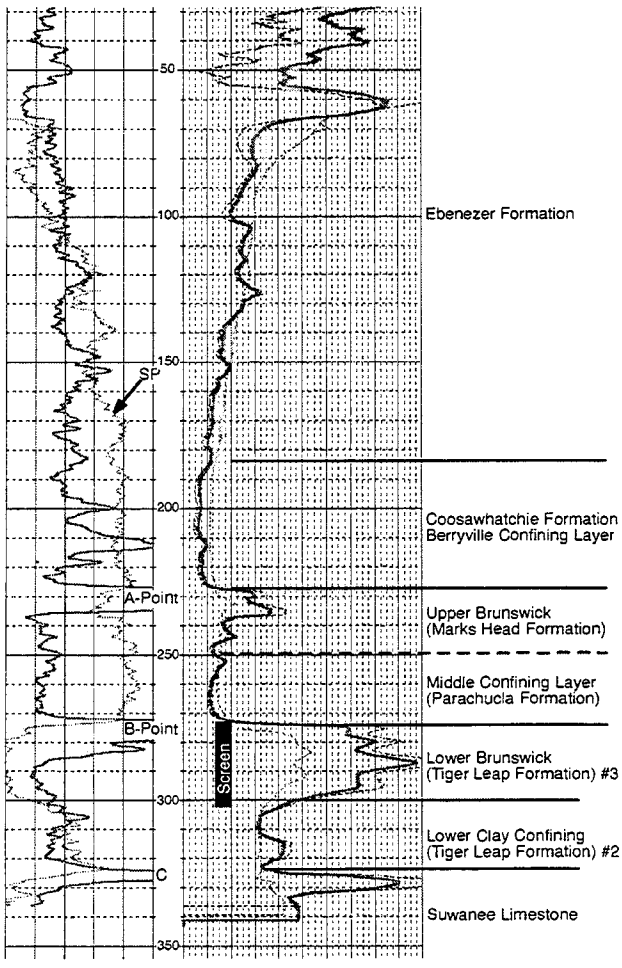

Figure 4. Borehole geophysical log Genesis Pointe, test well no. 1

electronic water level sensor in the pumping well. The pumping rate averaged 88 gpm during the 48-hour test. Water levels were recorded in Test Well No. 2 with a data logger installed by the USGS as part of its coastal groundwater studies. Data were recorded at 30-minute intervals 3 days prior to the start of the 48-hour test to collect background water level data. During the pumping and recovery period, data were collected at 2-minute intervals.

The data from Observation Well No. 2 were analyzed utilizing the data analysis program, Infinite Extent version 4.0 by Starpoint Software. The data were matched to type curves using the Theis method for confined aquifers. The calculated transmissivity from the drawdown data was 2,274 ft ^{2}/day, the hydraulic conductivity was 90 ft\day, and the aquifer storativity was 7.3 x 10^{-5}. The calculated transmissivity for the recovery data was 2,698 ft ^{2}\day, the hydraulic conductivity was 108 ft\day, and the aquifer storativity was 5 x 10^{-5}.

The drilling, borehole geophysical logging and 48-hour aquifer test of Test Well No. 1 demonstrated that the lower Brunswick aquifer is capable of supplying 280 gpm of good quality water from a properly constructed 10-inch diameter screened and gravel-packed well for the Genesis Pointe Tract in Bryan County, Georgia. Water levels in the lower Brunswick aquifer at the Genesis Pointe Tract are shown on Figure 5. These changes represent seasonal background conditions prior to development.

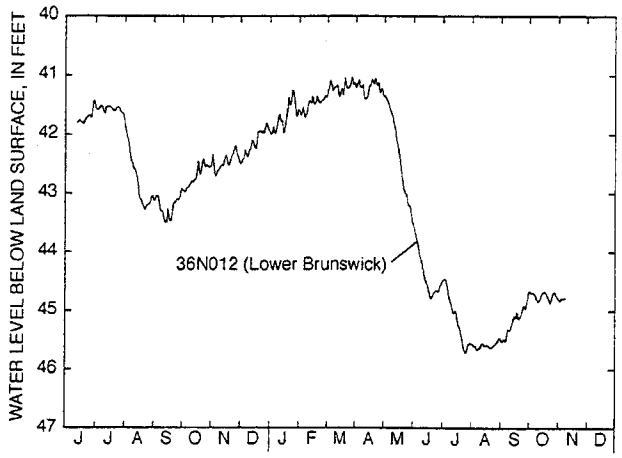

Figure 5. Waterlevels in the lower Brunswick aquifer at the Genesis Points Tract, Bryan County, Georgia, 1999-2000.

FUTURE STUDIES

Current studies being conducted by the Georgia EPD, as part of the Sound Science Initiative, are adding to our understanding of the regional hydrologic characteristics of the upper and lower Brunswick aquifers in Bryan, Chatham, Effingham, and Glynn Counties, Georgia. Additional well sites in Glynn County to test the Surficial and upper Brunswick aquifer are planned at Ebenezer Bend on the South Altamaha River. Geologic studies of the Miocene sediments by the USGS (Edwards and Weems, 2000) are adding to our understanding of the hydrostratigraphy. Maps showing the distribution of permeable units in the Surficial and upper and lower Brunswick aquifers are planned for completion in the near future by JJ&G. These will assist the USGS in developing a hydrologic framework for its groundwater flow model of the 24-county coastal area of Georgia.

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